Abstracts List

POL01
Silica nanoparticles as dexamethasone delivery systems able to induce the osteogenic differentiation of human bone marrow-derived mesenchymal stem cells

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Bioactive glasses, especially silica-based materials, are reported to present osteoconductive and osteoinductive properties, fundamental characteristics in bone regeneration [1,2]. Additionally, dexamethasone (Dex) is one of the bioactive agents able to induce the osteogenic differentiation of mesenchymal stem cells by increasing the alkaline phosphatase activity, and the expression levels of Osteocalcin and Bone Sialoprotein [3]. Herein, we synthesised silica (SiO2) nanoparticles (that present inherent bioactivity and ability to act as a sustained drug delivery system), and coated their surface using poly-L-lysine (PLL) and hyaluronic acid (HA) using the layer-by-layer processing technique. Further on, we studied the influence of these new SiO2-polyelectrolyte coated nanoparticles as Dex sustained delivery systems. The SiO2 nanoparticles were loaded with Dex (SiO2-Dex) and coated with PLL and HA (SiO2-Dex-PLL-HA). Their Dex release profile was evaluated and a more sustained release was obtained with the SiO2-Dex-PLL-HA. All the particles were cultured with human bone marrow-derived mesenchymal stem cells (hBMSCs) under osteogenic differentiation culture conditions. hBMSCs adhered, proliferated and differentiated towards the osteogenic lineage in the presence of SiO2 (DLS 174nm), SiO2-Dex (DLS 175nm) and SiO2-Dex-PLL-HA (DLS 679nm). The presence of these materials induced the overexpression of osteogenic transcripts, namely of Osteocalcin, Bone Sialoprotein and Runx2. Scanning Electron Microscopy/Electron Dispersive Spectroscopy analysis demonstrated that hBMSCs synthesised calcium phosphates when cultured with SiO2-Dex and SiO2-Dex-PLL-HA nanoparticles. These results indicate the potential use of these SiO2-polyelectrolytes coated nanoparticles as dexamethasone delivery systems capable of promoting osteogenic differentiation of hBMSCs.

References

[1] Arcos, D., Vallet-Regí, M., Acta Biomaterialia 6, 2874 (2010);
[2] Gribova, V., Auzely-Velty, R., Picart, C., Chemistry of Materials 24, 854 (2012);
[3] Son, J., Kim, S., Oh, J., Appleford, M., Oh, S., L Ong, J., Lee, K., J Biomed Mater Res A. 4, 638 (2011).

POL02
Cytotoxicity evaluation of hydroxyapatite-nanoparticles in vitro – finding a test-system to resemble the in vivo situation

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Biomaterials based on nano-particles have gained increased attention because of its potential application in several medical fields including tissue engineering (TE), dentistry and pharmacy. We aim to study the effects of nanoparticles suited for TE strategies on cells in vitro as well as in vivo. Ostim® is a nano-hydroxyapatite aqueous paste approved for clinical use as bone defect filling matrix. In a previous study in a bone defect model, Ostim® showed to support bone formation with no inflammatory reaction of the surrounding tissue [1]. Interestingly, the addition of the paste on cultured cell in a typical cytotoxicity test set-up resulted in a toxic effect in vitro. When exposing the cells to the particles in transwell-sytems, we were able to demonstrate that direct cell-particle contact leads to cytotoxicity, which was further analyzed by TEM. To optimize in vitro test systems for biomaterials to meet the in vivo situation, we embedded cells either in fibrin matrix prior to the addition of the particles or placed the material between two layers of viable human amnion. Subsequently, cell viability of the embedded cells or the cells of the amniotic membrane was quantified. Placing the paste between stretched amniotic layers showed results comparable to the in vivo situation. This test system presents a promising candidate for biomaterial evaluation.

1. D. Busenlechner, S. Tangl, B. Mair, G. Fugger, R. Gruber, H. Redl, und G. Watzek, „Simultaneous in vivo comparison of bone substitutes in a guided bone regeneration model", Biomaterials, Bd. 29, Nr. 22, S. 3195–3200, Aug. 2008.

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